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# A Twin of the Great Lisbon Earthquake (Based on Materials from the Newspaper *Sankt-Peterburgskie vedomosti* for the 18th Century)

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**Abstract**—The article generalizes materials on the earthquake of March 31, 1761, which is almost unknown in our scientific discourse, although very significant in its seismological impacts; it can therefore be considered as a twin of the Great Lisbon disaster of November 1, 1755. The 1761 earthquake struck a large part of Europe and, although it did not involve such disastrous consequences as the 1755 Lisbon quake, it significantly changed the seismic regime observed after after the latter. Both earthquakes were followed by tsunamis on the western margins of Europe and the eastern coasts of North America; they also triggered seismic activations of vast, spatially different regions in Western Europe and North Africa. It is possible to associate a number of strongest seismic events in the West Atlantic region with the 1761 earthquake. In the recent research literature on the topic, predominantly by Portuguese authors, the sources of both earthquakes are located in the eastern part of the Azores–Gibraltar Transform Fault. It is of particular interest that the initial data for this article were taken from the newspaper *Sankt-Petersburgskie vedomosti* for the 18th century and were supplemented with information from historical catalogs and recent foreign papers.

**Keywords:** Lisbon earthquake, earthquake of March 31, 1761, seismic activation, tsunami, historical sources, *Sankt-Petersburgskie vedomosti*

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## INTRODUCTION

The Great Lisbon earthquake of November 1, 1755, which was the strongest in Europe, with a magnitude of $M = 8.5–9.0$ and of intensity $I = X$ (Gutscher et al., 2006), has remained a focus of research more than 250 years on. This event caused tsunamis and destruction to various degrees and changed the hydrological regime in a considerable part of Europe, North Africa, and most of the Atlantic water area up to the American coast. A large amount of research publications are devoted to this earthquake; it has also been reflected in European culture. With respect to new seismological, geodynamic, ecological, social, and economical viewpoints, it has been repeatedly considered.

Along with it, another earthquake with a closely located source and similar energy has long remained little known (in the Russian literature, this is still the situation): an earthquake that occurred on March 31, 1761, five and a half years after the Lisbon disaster. The nature and consequences of this earthquake, with emphasis on its tsunami-triggering impact, has been studied in recent years predominantly by Portuguese researchers. Note that precisely historical records are an important, if not the main, source of information for actual research. It seems feasible to generalize the information about this strong earthquake, one of the strongest in Atlantic Europe during the historical period, for a deeper study to reveal the geodynamic peculiarities of the paired earthquake source in East Atlantic and how they have affected the seismic regime in continental Europe.

Surprisingly abundant information about the earthquakes of November 1, 1755, and March 31, 1761, and the associated seismic regime has been found among 18th century articles in the newspaper *Sankt-Peterburgskie vedomosti* (hereinafter, SPV for brevity), which were analyzed in a study supported by the Russian Foundation for Basic Research (grant for 2017–2019). This newspaper extensively reviewed various natural cataclysms in the world; however, we emphasize that the information about the mentioned earthquakes has not been been considered in earlier studies. Multiple reports about the Lisbon disaster, mainly stories of direct eyewitnesses or retellings of others' narrations, had been published in the newspaper beginning from at least December 1755. For example, only in 1756 was the Lisbon earthquake the main topic in the newspaper, with more than 30 dispatches published; these made it possible to infer the character of

the seismic regime in Europe and its abrupt change after the earthquake of March 31, 1761.

It is this concise information about the Lisbon earthquake itself and the subsequent seismic process—which involved not only a considerable part of Western Europe, but also the Atlantic coastal region of Africa—that allowed an extraordinary seismic activation to be noticed after November 1, 1755: this activation was not limited to aftershocks—it was also reflected in more or less simultaneous shaking of spatially distant areas outside the aftershock zone. The information from SPV was supplemented with data from a number of historical earthquake catalogs; as a result, the temporal and spatial limits of particular stages of this activation were constrained. The similar approach was successfully applied earlier to analyze and use historical sources for studying past seismic and volcanic phenomena in other regions of the world (Ioganson, 2018, 2019a, 2019b). Such practice has also proven useful in the present study.

## WAVES OF SEISMIC ACTIVATION AFTER THE LISBON EARTHQUAKE OF NOVEMBER 1, 1755

The series of earthquakes that followed the main shock of November 1, 1755, can be naturally grouped into several "waves" of seismic activations. The chronologically first wave lasted from November 7 to 27, 1755, and caused shaking in Central France (Auvergne), northwest England (Cumberland), most of Switzerland, Gibraltar, southern France (Besançon), and the east coast of America. In the course of this activation, destructive shocks that can be considered aftershocks of the Lisbon earthquake were reported on November 18 and 19 in the African coastal cities of Fez and Meknes (Morocco) (Mallet, R. and Mallet, J.W., 1858). This wave ended on November 26 and 27 with the occurrence of earthquakes in the French–Belgian border region (Charleville) and in Belgium (Liege).

The second wave of seismic activation occurred in December 1755 and was the strongest, longest, and most spatially extensive in Western Europe. It had started with the aftershock of December that was felt in Lisbon; this shaking was the strongest after the shock of November 1. In the period since December 9 until 31, the shocks were felt in different parts of Western Europe: on the southern coast of Italy, in the Italian and Swiss Alps, the other parts of Switzerland and in Austria; in southern, southwestern, and northern Germany; in southwestern, southern, and southeastern France; in Belgium and the Netherlands; even in England and Scotland. On December 19, the earthquake reoccurred in American regions that had been struck earlier, on November 17–19. Thus, the seismic activation of December 1755 encompassed both parts of Northern (including northern Scotland, Germany, Belgium, and the Netherlands) and Southwestern Europe (including a considerable part of Switzerland, southwestern France, northern Italy, and some of Spain). It is remarkable that the earthquakes were not felt from a single source, but were likely generated by individual activated seismic sources.

The final, third wave occurred in February 1756 and encompassed the territory from Northern Europe to the Alps. The earthquakes were reported not only in the same locations of Belgium and northern Germany where the November activation had been felt, but also in some new areas in northern France, the Netherlands, and northern Germany. On the present-day seismic hazard map for Western Europe, the highest seismic hazard zones correspond exactly to the areas where the seismic activations of December 1755 and February 1756 had been felt. According to the SHEEC catalog (The SHARE..., 2012), the epicenter of the February 18, 1756 earthquake with $I$ = VIII and $M$ = 5.7 was located in Düren (northwestern Germany); these are the highest recorded shakings in the Lower Rhine region. In geological structures, the northern Germany earthquakes are in the Rhine Graben zone (namely, its upper, middle, and lower parts). As for France and England, seismic shakings have not been linked with certainty to any geological structures (Grünthal, 1999).

After February 1756, the earthquakes occurred episodically in different areas where the February events had been felt; however, these single events cannot be grouped in a series.

## THE MARCH 31, 1761 EARTHQUAKE AND ITS SEISMOLOGICAL CONSEQUENCES

The earthquake that occurred on March 31, 1761 played a key role in changing the seismic regime of a vast region, triggered a new wave of seismic activation, and is of the fundamental value for assessing the geodynamic situation, the seismic scenario of which included the evolution of the Lisbon disaster and subsequent events. This strongest event had struck in western continental Europe and virtually the entire Atlantic water area. Both eyewitnesses and authors of historical catalogs compare it to the earthquake of November 1, 1755. Nevertheless, this event later faded as a research topic, and the data on location of its source and perceived intensity were very contradictory.

For example, the location of its source varies in different parametric catalogs, which a priori pay no attention to the possibly outstanding character of any event. The catalog by J.M. van Gils and G. Leydecker (1991) indicates that the March 31, 1761 earthquake occurred in the Lisbon–Evora area, 130 km east of Lisbon, with an intensity of $I$ = VIII. According to the SHEEC catalog (The SHARE..., 2012), the epicenter was located in the ocean, west of Cape St. Vincent (36° N, 10.5° W), its magnitude was $M$ = 7.5, and shaking in adjacent Europe was $I$ = VI–VII (according

to the respective shaking map). The Portuguese seismic catalogs also provide significantly different data for this event. For example, J. Mezcua and J.M.M. Solares (1983) provide epicentral coordinates of 37.00° N, 10.00° W, while C.S. Oliveira (1986) indicate 36.00° N, 10.50° W. The shaking intensity at the epicenter also varies: $I$ = VIII (Munuera, 1963), $I$ = IX (Mezcua, Solares, 1983), and $I$ = VIII–IX (Oliveira, 1986) (the summary is taken from (Baptista et al., 2006)).

Because the March 31, 1761 earthquake generated one of the most powerful historical tsunamis, in recent years this event has become the focus of in-depth studies to reveal both general and particular problems of tsunami-triggering earthquakes, and a number of publications are already available on this topic, e.g., (Baptista et al., 1998, 2006; Baptista and Miranda, 2009, Baptista, 2020; etc.).

Crucial information indicating the extraordinariness and therefore importance of the event was revealed in the SPV. For example, a short dispatch, based on news from June 19, 1761 from London, read as follows (hereinafter, direct citations from the SPV are translated to reflect the original old-Russian style whenever possible): "On March 31 of this year, a particularly notable event occurred on Barbados: the sea undulated like water in a shaken washbasin, and the seafloor could be seen from the shore for a whole minute; after this water, seawater again rose so high that people were terrified, expecting some great flood. On the November 1, 1755, the same was noted during the earthquake in Lisbon; thus, on Barbados they concluded that the severe earthquake had occurred somewhere else, maybe even in Lisbon" (SPV, July 13, 1761). (Note: Barbados is the easternmost island in the Lesser Antilles.)

The assumptions of eyewitnesses about the possible strong earthquake in Lisbon were quite well founded, because, indeed, certain shaking was felt there on March 31, 1761, and this was also reported in the newspaper: "On the 31st of the month, a shaking of the earth occurred here and other places, especially on the coasts of the kingdom in this land; this shaking lasted about three minutes, however, no damage was done. In Kadiks (Cadiz. L.I.), it was very strong, and rivers undulated very intensively" (SPV, May 15, 1761). This was the strongest shock felt in Lisbon after November 1, 1755.

In order to reconstruct the full character of seismicity during and after the March 13, 1761 earthquake, data from the SPV were compared with the available catalogs; data from recent foreign publications on this earthquake were also taken into consideration.

Highly important information about this earthquake is contained in the historical catalogs compiled by K.E.A. von Hoff (1841) and R. Mallet and J.W. Mallet (1858). Much attention is paid to the event in both catalogs, and, additionally, detailed data were taken from the same sources (namely, the proceedings of the Royal Society of London with detailed descriptions of the events). For example, von Hoff's catalog (1841, p. 4) reports about the earthquake on March 31, on Madeira, and also "on the Azores islands of Terceira and Fayal (Faial), a strong earthquake followed on the same day and then shocks recurred two weeks after, until April 20, with three gorges being opened and lava flows erupting. Several ships near Lisbon felt the shock." Van Hoff emphasizes the similarity of this earthquake with the 1755 Lisbon earthquake, a feature of which was that its shaking propagated from the east, "beginning from the Lisbon meridian," and the broad extent of shaking in the Atlantic region, including Madeira, Azores, and the West Indies (the last point is suggested by the behavior of seawater on Barbados). On the Atlantic coasts of Europe, undulation of the ocean was noted by ship crews near Cape Finisterre (westernmost point of Spain), as well as on the Isles of Scilly (southwest of England) and in Cornwall (southwestern England), where the sea rose and fell five times by 4–5 ft (about 1.5 m), as well as on the coast of Ireland.

According to (R. Mallet and J. Mallet, 1858), the March 31, 1761 earthquake was felt across the entire western coast of Portugal (Lisbon, Setúbal, Portu; damage was reported in the last city) and in Spain (Madrid and other localities), as well as in Amsterdam ("lamps were shifted by a foot"); in La Coruña, houses were not destroyed, but were shifted; fissures formed in the soil, and sand with shells were thrown up. Undulating of the sea is described the same way like in (von Hoff, 1841); however, with some additions about the underground hum heard by sailors, sudden shocks felt on ships, and even holes in the bottoms. The catalog (Mallet, R. and Mallet, J.W., 1858) does not indicate shaking on land that accompanied undulation of the sea on Barbados, suggesting that the tsunami reached only the Western Atlantic.

M.A. Baptista et al. (2006) generalized the data on macroseismic impacts of this earthquake based on dispatches in contemporaneous Lisbon and London newspapers, as well as excerpts from proceedings of the Royal Society of London. According to these data, the March 31, 1761 earthquake was felt in Lisbon at noon; it dismayed citizens and caused additional destruction on ruins left by the November 1, 1755 earthquake. The earthquake was followed by a tsunami observed in Lisbon (its height was estimated at 8 ft, or about 2.5 m). Sea level fluctuations were observed along the coasts of Spain up to Barcelona, as well as on Terceira (Azores), in Cornwall (England), Queenstown (present day Cork, Ireland), and on Barbados (Caribbean).

Thus, the data give grounds to conclude that the spatial extent of shaking caused by the March 31, 1761 earthquake was comparable to that of the 1755 Lisbon

earthquake; hence, the magnitude of this event was also extraordinarily large.

Let us consider several other dispatches from the SPV that continued the topic of the earthquake. On May 22, 1761, the following dispatch was published: "From Lisbon, April 8: The recent shaking of earth has not done as much damage as expected from the start. Only one small child was killed. In other cities and towns of our kingdom, shaking was as strong as in the capital and lasted just as long. Several old churches and houses in different places collapsed, while it is believed that in total 25 people were killed in these incidents. In Onorpe and on the northern side of the kingdom, this shaking was felt much better, rather than on November 1, 1755, and since it traveled from north to south, it is feared that in the north it was much more perceptible. The sea has not stopped undulating, and cracks are seen in nearly all houses. In Setúbal, many houses collapsed, while in Villafranca, everything is still standing on ground has subsided in many places; many shells have been thrown up. During the shaking, many convicts escaped from prisons, thus guards have been placed on all roads...." (SPV, May 22, 1761).

The next dispatch from Lisbon of April 21 was published on June 5: "Shaking of the earth continues, and although weak, people are afraid that this will not end until some fire-spitting mountain, like Etna in Sicily, Vesuvius in Italy, and Gekla in Iceland, appears somewhere in this kingdom" (SPV, June 5, 1761).

Finally, a very important dispatch was sent from Lisbon on June 10 on the strong earthquake on Terceira, in the Azores: "A dispatch was received from Terceira that a horrible shaking of the earth occurred there on April 15, and in the town of Angra, almost all houses were damaged so that nearly all inhabitants had to live in fields in huts. Fortunately, a very large fissure formed one mile from the town, and the shaking ended. Flame is constantly erupting from this fissure" (SPV, August 3, 1761).

Even these, entirely descriptive data from the SPV indicate that the strongest seismic event occurred and was felt not only within a considerable part of Portugal, but also, importantly, in a vast region of the Atlantic: its impacts were felt on Barbados, on the other side of the Atlantic Ocean, and caused a series of aftershocks, including on Terceira. This is also indicated by the long-term influence of this earthquake on the seismic regime in continental Europe, on the Atlantic coast of Africa, and in most of the North Atlantic. This earthquake triggered a new wave of seismic activation not only in the vast region of Western Europe (predominantly its southern part), but also in almost the entire Atlantic water area.

Weaker earthquakes were felt in Lisbon and Portugal as a whole after March 31, 1761, and this may have been the respective series of aftershocks. According to the information from the SPV, shocks occurred almost every day until November 1761, then, with certain quiet periods, until January 1765 (SPV, January 4, 1762 and March 1, 1765)—as a result, the shocks lasted until 1769. Since 1762, seismic activation involved the southern parts of Western Europe, and Lesser Asia: e.g., an earthquake with $I$ = IX and $M$ = 5.6 occurred on October 6, 1762 in the Italian province L'Aquila (van Gils and Leydecker, 1991; The SHARE..., 2012).

The following strong earthquake occurred on June 28, 1763, at the Hungarian–Slovakian border. According to the SHEEC catalog (The SHARE..., 2012), the epicenter of this earthquake with $I$ = IX and $M$ = 5.7 was close to a locality called Komarno (present day Slovakia); according to the corresponding shaking map, seismic waves traveled across almost the entire territory of Slovakia, northeastern Hungary, and eastern Austria. According to (Mallet, R. and Mallet, J.W., 1858), the earthquake was felt in the entire territory of Hungary, including Budapest; and shaking was felt even in Dresden and Leipzig. These facts were regularly published in SPV, although with various degrees of detail, and the seismic activation lasted until December 1765 (SPV, January 24, 1766).

In August 1766, the following seismic activation involved the regions of Central Europe and Lesser Asia. In (van Hoff, 1841), the earthquake in Vienna is dated to August 8, 1766. According to (Mallet, R. and Mallet, J.W., 1858), the date of the strong earthquake in Vienna (in particular, on the Austrian–Hungarian border) is August 5. Simultaneous strong shocks were felt in Constantinople (Istanbul), Adrianople (Edirne), Thessalonica, and Smyrna (Izmir), as well as in the other areas of present-day Turkey and Greece. The catalog by van Gils and Leydecker (1991) indicates that the earthquake occurred in Burgenland (eastern Austria) on August 5, with $M$ = 4.6 and $I$ = VII. Additionally, the strong earthquake occurred on the same day on the coast of the Sea of Marmara, with $M$ = 7 and $I$ = X (The SHARE..., 2012).

The shocks in Constantinople and other areas continued in 1767–1769. On July 14, 1767, an earthquake with $I$ = IX occurred (The SHARE..., 2012). On February 27, 1768, a strong earthquake occurred, with the epicenter near Brunne-Steinfeld (south of Vienna), $M$ = 5.4, and $I$ =VIII, which was felt in all of eastern Austria (van Gils and Leydecker, 1991; The SHARE..., 2012), as well as in Bohemia; this event caused flooding of the Danube (within present-day Slovakia). On February 6, 1769, a shock with I = VII was felt in Lisbon, and this probably terminated the series of aftershocks.

Except for the provided indications of seismic activations on two adjacent continents, a peculiar seismic activation was also reported in the Northwest Atlantic. Single shocks began to be reported here since 1761, whereas in 1765, the series of earthquakes had begun to involve the West Indies, then the entire Atlantic part of South America. For example, according to (Mallet, R.

and Mallet, J.W., 1858), several shocks occurred on March 15, 1765, on Dominica, and their intensity was higher than any of the reported before; about 150 shocks were recorded in February and March, and shocks in general lasted until June. On June 11, 1766, a strong earthquake struck Jamaica and Cuba. From July 15 to 21, shocks were reported on Santa Maria Island in South America. The earthquake of August 13, 1766, on Martinique was accompanied by a strong hurricane (Hoff, 1841; Mallet, R. and Mallet, J.W., 1858).

The 1766 series of earthquakes in the Caribbean Basin can be called a "seismic storm." SPV published a number of dispatches about these events, in particular, about the storm and the earthquake on Martinique in August 1766: "This month, on 13th, 14th, and 15th, a severe storm on the island of Martinique occurred, followed by a strong earthquake, which terribly shook this island. The town of St. Pierre, except for only several houses, was ruined, with 1600 people buried and many more injured. In different harbors of the island, 80 ships were sunk, among them 47 French, and a large part of the island was flooded by the sea. This earthquake was felt on the entire island, and its consequences should have been very horrifying. Because of this, some adjacent islands, big and small, were also devastated" (SPV, November 10, 1766).

Among these events on the northeastern coast of South America and the Lesser Antilles, a particularly strong earthquake that occurred on October 21, 1766 and struck Dutch Guiana (present-day Suriname), Caracas (Venezuela), and the island of Trinidad is particularly remarkable. In Caracas shocks recurred every day until late 1767. The town of Cumana (the coast of Venezuela) was completely destroyed. According to (Mallet, R. and Mallet, J.W., 1858), the earthquake continued until the end of 1767–beginning of 1768. The same catalog indicates that another destructive earthquake occurred on June 3, 1770, on Haiti; Port-au-Prince was especially damaged.

## CONCLUSIONS

Thus, the March 31, 1761, earthquake caused new seismic activation in the 1760s with a different spatial distribution of seismicity. In contrast to the Lisbon earthquake of November 1, 1755, when the seismic process involved predominantly the northern and central parts of Western Europe, the March 31, 1761 earthquake led to activation of seismic sources in the southern part of Western Europe and the entire western part of the North Atlantic. It is this activation that caused multiple destructive earthquakes in the Caribbean Basin and on the northern coast of southern America in the 1760s.

In this respect, it should be noted that the earthquakes with intensities believed to be considerable for France, northern Germany, and Switzerland, which occurred during the post-Lisbon activation, were likely related to long-lived seismotectonic structures. This is probably indicated by the recurrence of earthquakes in the same areas (Düren in northern Germany and Brig in the Swiss Alps). These structures should be studied in more detail to obtain a more reliable seismic hazard assessment.

One of the unresolved problems regarding the March 31, 1761 earthquake is the uncertainty in locating its source (however, the same is applicable to the 1755 Lisbon earthquake) both in geographic and tectonic senses. The only point which all researchers share is that the source of the 1761 earthquake was located in the Atlantic Ocean, west of the Portuguese coast. Baptista et al. (2006) considered several versions of the source location for this earthquake, and a broad variation was shown, depending on the more preferable historical data chosen: (1) 43° N, 12° W; (2) 34.5° N, 13° W; and (3) 36° N, 10.5° W. Baptista et al. (2006) believe that the most acceptable coordinates are 34.5° N, 13° W. Importantly, these authors also considerably elevated the status of this earthquake, the strongest, proceeding from an analysis of its tsunami-triggering effects, and suggested its magnitude at about 8.5.

Structurally, the sources of both earthquakes are linked to the complex tectonics characteristic of the eastern part of the Azores–Gibraltar Transform Fault (Gutscher et al., 2006; Baptista and Miranda, 2009; Bezzeghoud et al., 2014; Grevemeyer et al., 2017; Baptista, 2020). Note that the source of the 1755 Lisbon earthquake is located considerably closer to the coastline than the source of the March 31, 1761 earthquake. Obviously, the different distance to the shore is what caused the different destructive impacts from these two events on the continents of both sides of the Atlantic. In any case, it is clear that both events occurred in the Atlantic water area, where the system of transform faults (including the aforementioned Azores–Gibraltar Transform Fault) branching from the Mid-Atlantic Ridge (MAR) is located, corresponding to the boundaries between large tectonic units and running from the MAR axis to the continents. In this respect, these are technically not earthquakes, but seaquakes, indicating activation of the mentioned geodynamic system.

Based on the above data on the unprecedented seismic activation in spatially distant regions (northern Germany, southeastern France, southern Scandinavia, and the Alps during the first series triggered by the 1755 Lisbon earthquake, in contrast to the activation predominantly in the Southern Mediterranean, on islands in the Atlantic Ocean, and on the eastern coast of America during the second series triggered by the March 31, 1761 earthquake), a conclusion can be drawn about the poorly studied relationship of geodynamic processes in the oceanic and continental lithosphere.

However, now, in the light of facts that previously had not been taken into consideration, the Great Lisbon earthquake can be viewed as only the first episode of an enormous seismic phenomenon that manifested itself instantly on the geological time scale but involved crust on a subglobal level. The seismic scenario of the 1750s was continued by seismic events of the 1760s in Atlantic Europe and America, as well as in the Atlantic Ocean itself. It can be expected that the recently revealed data on the strong March 31, 1761 earthquake, which occurred in the Atlantic Ocean, should become used by researchers in their respective scientific fields.

Lastly, it should again be emphasized how important historical data are in studying a seismic process, in particular, for the strongest and unique earthquakes, in order to unravel new aspects of the Earth's geodynamic activity accessible for direct observation.

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## CONFLICT OF INTERESTS

The author declares no conflict of interests.

## REFERENCES

Baptista, M.A., Tsunamis along the Azores Gibraltar plate boundary, *Pure Appl. Geophys.*, 2020, vol. 177, pp. 1713–1724.
https://doi.org/10.1007/s00024-019-02344-8

Baptista, M.A. and Miranda, J.M., Revision of the Portuguese catalog of tsunamis, *Nat. Haz. Earth Syst. Sci.*, 2009, no. 9, pp. 25–42.

Baptista, M.A., Miranda, P.M.A., Miranda, J.M., and Mendes, V.L., Constrains on the source of the 1755 Lisbon tsunami inferred from numerical modelling of historical data on the source of the 1755 Lisbon tsunami, *J. Geodyn.*, 1998, vol. 25, nos. 1–2, pp. 159–174.

Baptista, M.A., Miranda, J.M., and Luis, J.F., In search of the 31 March 1761 earthquake and tsunami source, *Bull. Seismol. Soc. Am.*, 2006, vol. 96, no. 2, pp. 713–721.

Bezzeghoud, M., Adam, C., Buforn, E., Borges, J.F., and Caldeira, B., Seismicity along the Azores-Gibraltar region and global plate kinematics, *J. Seismol.*, 2014, vol. 18, no. 2, pp. 205–220.
https://doi.org/10.1007/s10950-013-9416-x

Grevemeyer, I., Lange, D., Villinger, H., Custódio, S., and Matias, L., Seismotectonics of the Horseshoe Abyssal Plain and Gorringe Bank, eastern Atlantic Ocean: Constraints from ocean bottom seismometer data, *J. Geophys. Res.: Solid Earth*, 2017, vol. 122, no. 1, pp. 63–78.
https://doi.org/10.1002/2016JB013586

Grünthal, G., Seismic hazard assessment for Central, North and Northwest Europe: GSHAP Region 3, *Ann. Geofis.*, 1999, vol. 42, no. 6, pp. 999–1011.

Gutscher, M.A., Baptista, M.A., and Miranda, J.M., The Gibraltar Arc seismogenic zone (part 2): Constraints on a shallow east dipping fault plane source for the 1755 Lisbon earthquake provided by tsunami modelling and seismic intensity, *Tectonophysics*, 2006, vol. 426, nos. 1–2, pp. 153–166.

Ioganson, L.I., Analysis of historical sources on earthquakes in Crimea, *Seism. Instrum.*, 2018, vol. 54, no. 3, pp. 314–326.
https://doi.org/10.3103/S074792391803012X

Ioganson, L.I., Seismic activations in Italy in the 15th–21st centuries, from historical data, *Seism. Instrum.*, 2019a, vol. 55, no. 2, pp. 209–219.
https://doi.org/10.3103/S0747923919020075

Ioganson, L.I., A volcano in the Alps?, *Izv., Atmos. Oceanic Phys.*, 2019b, vol. 55, no. 8, pp. 840–845.
https://doi.org/10.1134/S000143381908005X

Mallet, R. and Mallet, J.W., *The Earthquake Catalogue of the British Association, with the Discussion, Curves, and Maps*, London, 1858.

Mezcua, J. and Solares, J.M.M., *Sismicidad del área Iberomogrebí*, vol. 203 of *Inst. Geogr. Nac. Publ.*, Madrid: Inst. Geogr. Nac., 1983.

Munuera, J.M., *Datos básicos para un estudo de sismicidad en la región de la Península Ibérica*, vol. 32 of *Mem. Inst. Geogr. Catastral*, Madrid: Inst. Geogr. Catastral, 1963.

Oliveira, C.S., *A sismicidade histórica em Portugal continental e a revisão do catálogo sísmico, Lab. Nac. Eng. Civil, Proc. 36/1177638, 235*, Lisbon, 1986.

*Sankt-Peterburgskie vedomosti*, May 15, 1761.

*Sankt-Peterburgskie vedomosti*, May 22, 1761.

*Sankt-Peterburgskie vedomosti*, June 5, 1761.

*Sankt-Peterburgskie vedomosti*, July 13, 1761.

*Sankt-Peterburgskie vedomosti*, Aug. 3, 1761.

*Sankt-Peterburgskie vedomosti*, Jan. 4, 1762.

*Sankt-Peterburgskie vedomosti*, Mar. 1, 1765.

*Sankt-Peterburgskie vedomosti*, Jan. 24, 1766.

*Sankt-Peterburgskie vedomosti*, Nov. 10, 1766.

The SHARE European Earthquake Catalogue (SHEEC) 1000–1899. https://www.emidius.eu/SHEEC/. Accessed December 31, 2020.

van Gils, J.M. and Leydecker, G., *Catalogue of European Earthquakes with Intensities Higher than 4*, Luxembourg: Comm. Eur. Commun. Nucl. Sci. Technol., 1991.

von Hoff, K.E.A., *Chronik der Erdbeben und Vulcan-Ausbrüche*, Gotha, 1840–1841.

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